THEATER CONSTRUCTION MANAGEMENT SYSTEM

By Mr. Chris Boyd

In September 2002, the U.S. Army Corps of Engineers (USACE) challenged the Army Facilities Component System (AFCS) branch of the USACE Engineering and Support Center, Huntsville, Alabama, to overhaul the planning and design tool called Theater Construction Management System (TCMS) version 1.2E. The Huntsville AFCS team released TCMS version 2.0 on 1 December 2003. This release is a complete overhaul of the TCMS structure and the underlying AFCS database, making version 1.2E obsolete and incompatible with version 2.0.
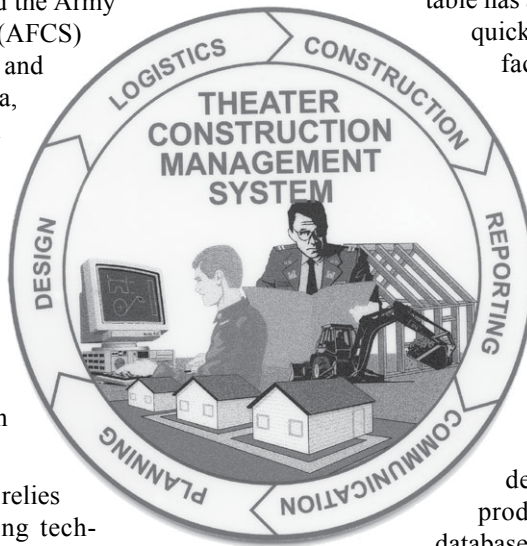
The significance of this overhaul relies on the knowledge of the underlying technology. The Construction Engineering Research Laboratory developed the early programming for TCMS more than 20 years ago to access the existing AFCS digital database. That version of the program was based on a Microsoft® disk-operated system that used external drives and was limited by floppy disks and hard drive space. The AFCS branch added functions and interface options within the 16-bit Microsoft Windows® operating system. However, each change was an add-on instead of an integrated, planned programming adjustment. This created an unstable operating environment and limited the enhancements that users needed. TCMS stayed 16-bit-based until 2003, even though 32-bit programming was introduced in 1995. This meant that version 1.2E and earlier versions of TCMS are limited to old and outdated commercial off-the-shelf (COTS) software, while the overhauled version 2.0 can interface with the latest version of Microsoft Project and AutoCAD® and run on a native Microsoft Windows XP environment. This lets users take advantage of current COTS.

TCMS interfaces seamlessly with the AFCS database and COTS software. There are tables that allow users to search or query the AFCS database. The "facility" table enables users to look up various facilities and view the bill of materials (BOM), labor, or drawings associated with that facility. (Note: TCMS uses the term "facility" to identify any item that serves a purpose and contains a construction sequence. This could be a warehouse, an administration building, hardstand, a 1-mile increment of ro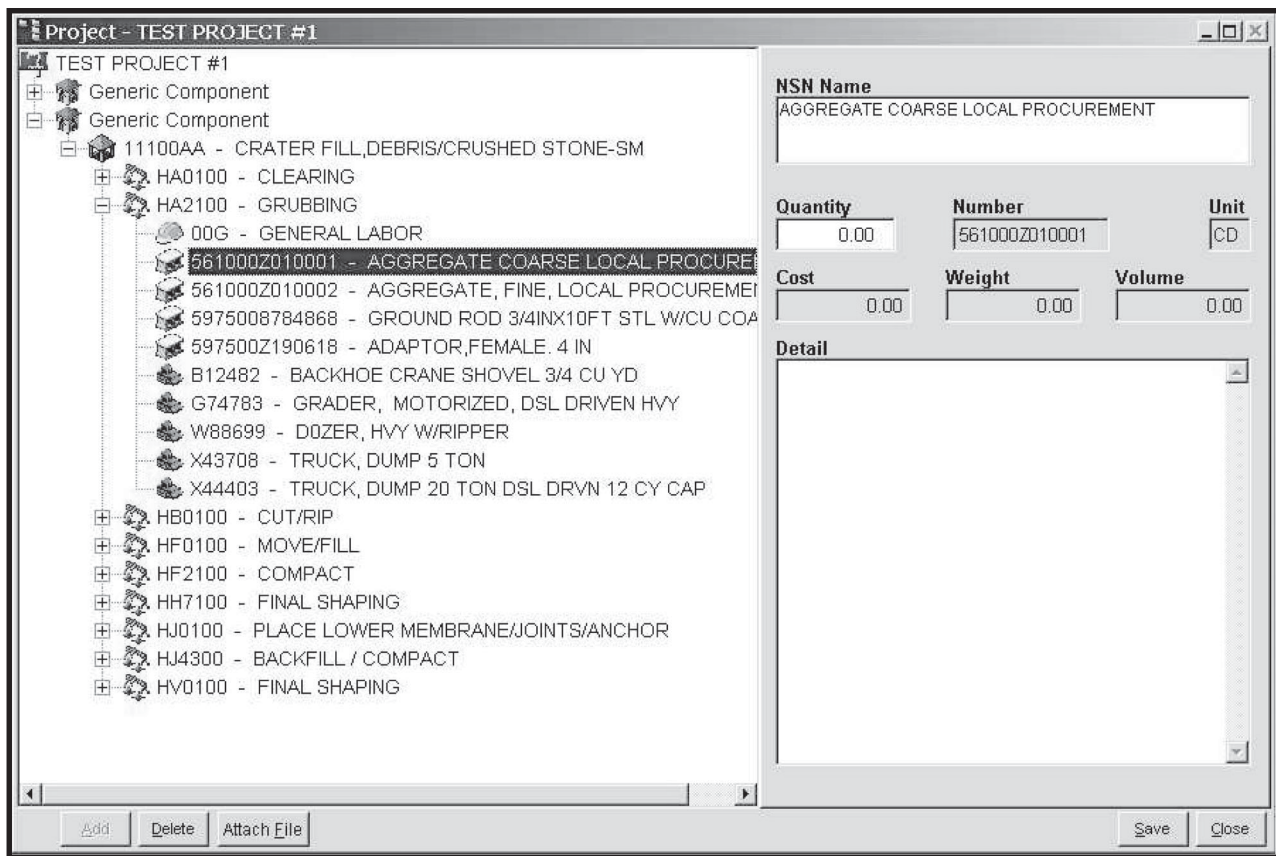ad, 1,000 feet of fence line or runway, bomb damage repair, a latrine, or a dining hall.) The facility table has a search filter that makes finding items quick and easy. There are more than 4,700 facilities in TCMS, including initial or temporary construction standards, various types of construction materials, and different climates and terrain. Vertical and horizontal construction are represented in the extensive database. The drawing table accesses more than 2,000 AutoCAD drawings which, when drawn into a computer-aided design (CAD) program, allows users to adapt a standard drawing to the site or situation. Items such as truss plate detail, material takeoffs, and detailed production drawings are included in the database. This resource alone gives users a leg up on construction planning and execution. The program views CAD drawings with an internal viewer, letting users view and print drawings without leaving the TCMS environment. TCMS also allows the transfer of data mined from AFCS to Microsoft Project in logical sequences. This transfer of data in construction sequence, along with the import of user-defined resources, gives a decent Gantt chart without much of the stubby-pencil entry normally associated with developing such charts.

The AFCS database is the digitized information from Technical Manual (TM) 5-301, *AFCS Planning*; TM 5-302, *AFCS Design*; and TM 5-303, *AFCS Logistics Data and Bills of Materials*. These TMs were called the "Red Book" because of the red bindings encasing the standard drawing sheets. It took a footlocker to carry the TMs on a deployment, and it was a labor-intensive task to update and maintain them. They gave users information in the form of BOMs and labor for the facility, as well as drawings. The annual distribution of the TCMS replaced the publishing of the Red Books, and the Internet allows users to periodically update TCMS at *<http://www.tcms.net>*. This sometimes eliminates the need to mail new CD-ROMs. The Web site is also the place to go for technical information, program updates, training requests, and general TCMS information.

Changing TCMS meant thinking outside the box for the development team. Each part (programming, data, and drawings) could not be changed separately; each would

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Sample Project Screen Shot

happen simultaneously. The tough part was not knowing if everything would work when all the parts were put together. The programming was updated to Visual FoxPro®. This was a major adjustment because 32-bit programming language allowed the arcane keystrokes method of version 1.2E to be supplanted by "point-and-click" commands. The programming also changed the way projects are viewed, using a graphic tree structure and icons. Seeing the relationships among component, facility, construction sequence, BOM, and labor allows users to make "drag-and-drop" project edits, as well as quantity changes, without losing sight of the overall project. Having multiple windows or tables open at the same time no longer locks the system. Using 32-bit programming ensures the life cycle of TCMS for years to come and allows it to interface with other 32-bit COTS software, giving the user access to the productivity gains associated with COTS. As the programming of TCMS/AFCS was being changed, the data structure of a facility was changed from the subfacility format to sequence. This change allowed the user to logically relate facility information. Each facility would now contain at least one construction sequence that would contain the labor to perform that sequence along with any materials that might be used during the sequence. For example, approximately seven construction sequences are used to build a warehouse. The drawing database expanded from 700 to more than 2,000 blocks, allowing the inclusion of production drawings and drawing details not previously available in TCMS. Including cross

sections of various road types, building footings, new campsite plans, Hesco® bastions, trusses, and other items, the database of drawings is a wealth of information. Combining all three changed elements created TCMS32, an engineering platform.

The engineering platform of TCMS32 allows the user to input local purchase materials by Federal Supply Code and country code. The user can input local labor resources and combine those into resource sheets for use in Microsoft Project. A feature that has limitless possibilities is the "attach file" function, which allows the user to attach any electronic file to the project. Now geographic information system (GIS) data, real estate data, contracts, after-action reviews, pictures, and any other file that can be found with Microsoft Internet Explorer can be archived within the project. Since a project is actually a TCMS32 ZIP file, those documents become a part of the project itself. Project labor production rates are adjustable, based on user input. The locally purchased materials list can be exported to other TCMS32 users, allowing the theater engineer to avoid bidding wars, inflated prices, and material shortages by using the same listing across an area of responsibility. Editing the locally purchased material listing for price, nomenclature, volume, and weight is quick and easy. The AFCS planning factors are now accessible in their own easy-to-find table. The biggest new feature is the "export" function under project reports. This allows the user to convert various BOM and labor project reports into Microsoft Excel, Microsoft Word, portable document format (PDF), or hypertext markup language
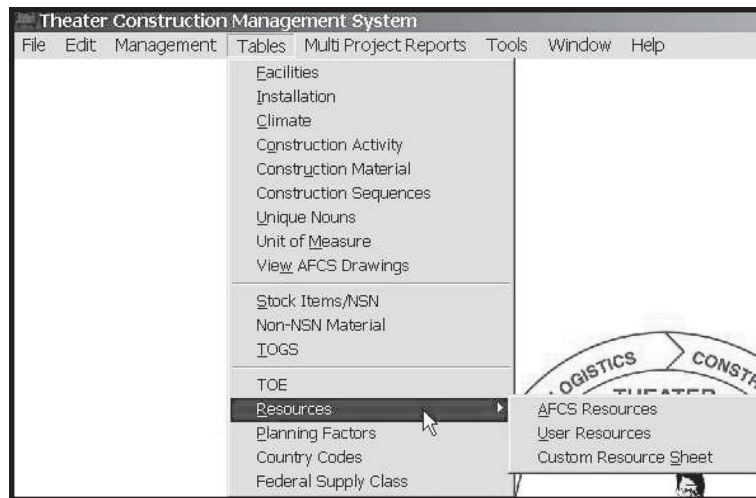
Screen Shot of Table Menu
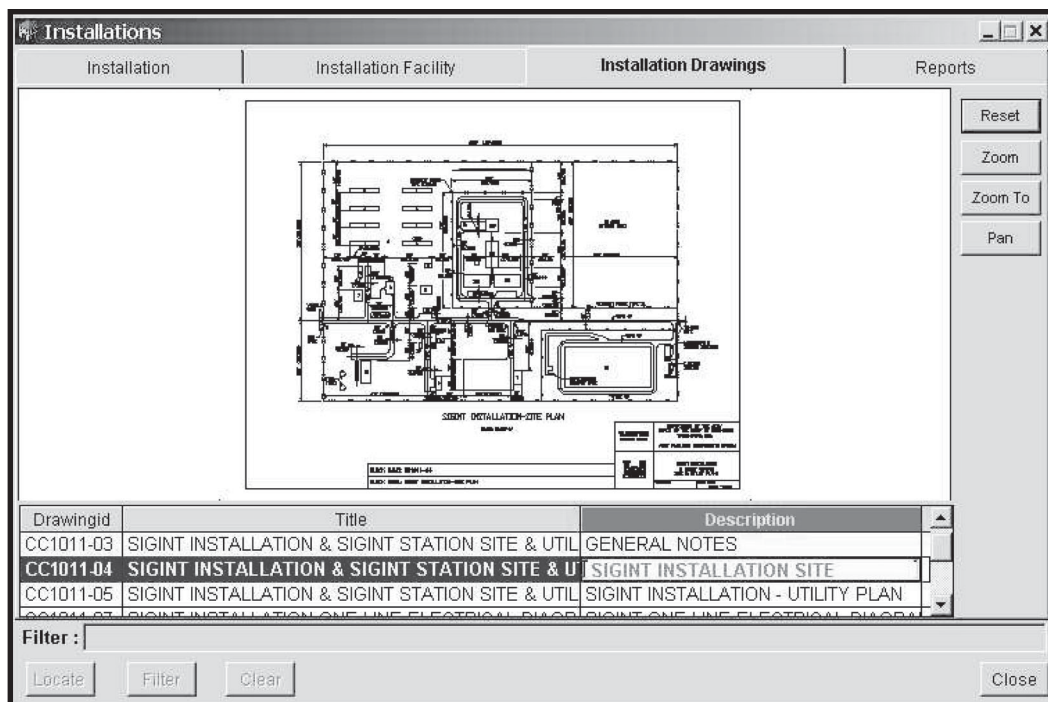
Screen Shot of Internal CADD Viewer

(HTML). The project progress report and the project summary can also be converted to other file formats. This enables the user to send project information to other persons in formats they can use outside of TCMS32. Development is underway to add Web-based training and application execution.

Future additions to TCMS32 should include a custom design function, allowing the user to quickly create from scratch a new three-dimensional design in minutes, including BOM, labor, and production drawings. It will also allow the user to change construction material on the fly and automatically adjust the BOM and labor. The COTS software for this exists today. TCMS32 should have a GIS capability to site-adapt facilities; a heating, ventilation, and air-conditioning module to forecast heating and cooling designs for buildings;

and a module to address the power requirements for base camps and individual facilities. The ability to interface with current Army reporting systems and TeleEngineering will help engineers provide TCMS32 data across the battlefield. These items are part of the future development of TCMS32. The planning for TCMS64, a 64-bit version, will occur in fiscal year 2005. This will ensure that TCMS as an engineering platform will not be outdated by improvements in technology. With continued funding, these planned updates will become reality.

Mr. Boyd is a military planner with the AFCS branch of the USACE Engineering and Support Center at Huntsville, Alabama.